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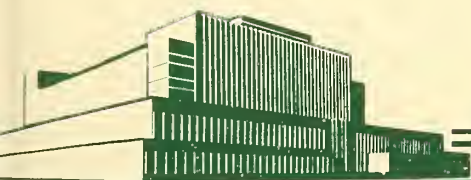
OPPORTUNITIES AND PROBLEMS IN UTILIZING WOOD
PRODUCTS IN THE SOUTHERN AND SOUTH CENTRAL FORESTS

By

J. A. HALL, Director



FOR PUBLICATION



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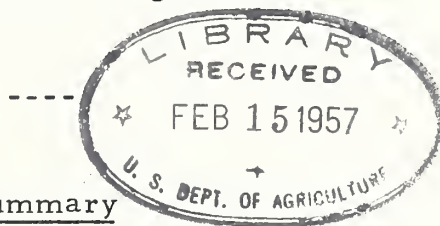
OPPORTUNITIES AND PROBLEMS IN UTILIZING WOOD PRODUCTS
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Forest Products Laboratory, ¹/₁ Forest Service
U. S. Department of Agriculture

Summary



Rebuilding of the South's pine forests and broader utilization of its hardwood stands are essential to the economic health of the region's forest industries. Southern pine lumber markets have suffered because of much low-quality lumber cut from small, low-grade trees typical of the understocked, poorly managed smaller forest ownerships. Intense competition for stumpage from the rapidly expanding pulp industry has resulted in premature heavy cutting. Full stocking, better stand management, integrated utilization, and better protection from natural enemies, together with genetic research aimed at higher-quality growing stock, are essential to the redevelopment of southern pine. New products such as laminated wood, fiberboards, and particle boards offer promise of utilizing small or low-grade timber and mill refuse.

Hardwoods predominate in many areas, including former pine lands. Cull trees exceed one-third of the hardwood growing stock. Improved quality is badly needed. Greater use of hardwoods for pulping will result from increased use of the semichemical processes. Fiberboards, charcoal, and new chemical processes under development can be expected to utilize much hardwood cull timber, permitting management practices designed to maintain essential supplies of high-quality sawtimber for lumber and veneer.

¹
-Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

OPPORTUNITIES AND PROBLEMS IN UTILIZING WOOD PRODUCTS
OF THE SOUTHERN AND SOUTH CENTRAL FORESTS¹

By

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The title of this paper is supposed to be "Opportunities and Problems in Utilizing Wood Products of the Southern and South Central Forests." That there are problems must be clear, or the program chairman would not have suggested that title. That there are opportunities must have been his opinion for the same reason.

I don't like to prophesy, and I would prefer that what I have to say shall not be taken as prophecy. All I can do is look at the trends, examine the current technical status, and forecast future technical developments. In this business of forecasting we get into trouble because future technical developments, while sound technically, may not fit into the economic picture. He would be a brash man indeed who tried to portray the status of forest products even 20 years hence as a result of the furious competition among materials in the United States.

It has now been over 26 years since I first saw the South with anything resembling a forester's eyes. They were not very well trained eyes, but some of the impressions received then and during the next few years are still very sharp and persistent.

The sawmill industry was predominant throughout. There were still many big mills, although a lot of them had already cut out and vanished. I remember being present when the Great Southern Lumber Company moved

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into its last tract of virgin pine at Bogalusa. Even then a far-sighted management had established large, successful pine plantations that were precursors of the greatest industry-financed reforestation program in history.

A major bone of contention was the amount of damage done to saw logs by the turpentine methods then in use. Such modern timber-conserving methods as bark chipping and chemical stimulation were not even a gleam in the researchers' eyes. Gum turpentine was still the major factor in naval stores, and most raw gum was processed in fire stills. McGarvey Cline was just getting under way with neliorexin, a steam-distilled, cleaned, standardized product. The big stumpwood operators were going good, but there was not an ounce of tall oil or sulfate turpentine or rosin produced in the South.

A few of the men I remember are Henry Hardtner, Charley Herty, Harry Wilson, Austin Carey, "Cap" Eldridge, H. H. Chapman, the McGowins, and Ernest Kurth. There were, of course, a lot of others who saw the great potential productive capacity of the southern pineries and were beginning to talk in terms which most of the industry did not quite comprehend. They recognized the value of pulp mills to the economy of the region, and believed that an active market for pulpwood would give intensive forestry a much-needed shot in the arm. But at that time there were only two pulp mills in the entire Gulf area; the great days of southern kraft paper had not yet dawned.

Austin Carey had demonstrated the high growth and yield capacity of slash pine, and H. H. Chapman was an ardent advocate of intensive management. Nobody had yet decided the true role of fire in southern forestry.

Charley Herty was demonstrating that young slash and longleaf pines were not so resinous that they could not be used for sulfite pulp.

Carl Curran, a Forest Products Laboratory associate, driving through the South with me, convinced me that newsprint and white papers in the South ought to be made from bleached kraft pine pulp and hardwood groundwoods, probably from such materials as tupelo, sweetgum, and cottonwood. Both men were right, but Curran's prediction has, I believe, been more accurate with respect to production of white papers. It was perfectly clear even then that a tremendous opportunity for well integrated utilization lay ahead in the South and that the crying need was for pulp outlets for pine. It was a little hard to foresee the enormous expansion of the kraft pulp industry, the decline of the sawmill industry in a great deal of the South, the

very great territorial shrinkage of the naval stores industry, and the very large increase in the production of turpentine and rosin as byproducts of pulp manufacture.

At the Laboratory, research was beginning into the relationships of soil moisture, stand density, growth rates, and the like, to the structure and properties of the pine wood produced. Even then it was perfectly clear that much of the fast-growing, second-growth pine produced in poorly stocked, unmanaged stands was not going to make acceptable lumber.

In the hardwood field the delta and other bottomland hardwoods were still a puzzle or, shall we say, a whole set of puzzles; a complex of many species that challenged the silviculturist and posed new utilization problems with respect to logging, sawing, seasoning, and machining. With the upland hardwoods we were more familiar, but I don't recall that anybody thought they were too much of a utilization problem in those years. We had not yet learned that under certain conditions hardwood forests can take over pine lands in the South, and I doubt if anyone anticipated the extent to which generally low-value hardwoods would invade cut-over pine country and pose the really difficult management-utilization problem facing us today.

Neither did we fully anticipate the magnitude of the effect of repeated high-grading on the size, quality, and species composition of our predominantly hardwood forests, both upland and bottomland.

There are three major problems, it seems to me, in the general task of achieving integrated utilization in the South and South Central States.

- (1) Most important, I believe, is the problem of restoring and maintaining adequate quality in southern pine lumber.
- (2) A corollary to (1) is the securing of a proper balance between pulpwood and sawtimber production in pine.
- (3) There must be developed mass utilization outlets for low-grade hardwoods that will make economically feasible and thus facilitate (a) the re-establishment of good pine stands on hardwood-invaded lands best suited to the production of pine; and (b) the improvement of the species composition, stocking, quality, and productivity of our once fine hardwood forests, both upland and bottomland.

Quality in Southern Pine Lumber

I do not expect to win any popularity contest for what I am going to say about the quality of present-day southern pine lumber. However, the repeated conferences we have had with the engineers of the Southern Pine Association, as well as with those in construction and fabrication industries, and with disgruntled consumers, plus the large amount of work we have done at the Laboratory on the problem, force us to a single conclusion: The quality of southern pine lumber has been going down for years, reached bottom during the war boom, and is still sufficiently low to injure seriously both the southern pine market and that of lumber as a whole.

I am well aware of the many exceptions -- of the fine companies that still grow and manufacture excellent lumber. I am also aware of the fine programs carried on by the Southern Pine Association, your local marketing groups, and many individual companies in the fields of forest management, equipment improvement, quality control, consumer education, and marketing. More power to you -- you need it all! For your good lumber is still swamped by and too often identified with a flood of unseasoned, poorly manufactured, ungraded lumber cut largely from small, rough, low-grade trees -- trees typical of the understocked, poorly managed stands that, unfortunately, predominate on the smaller forest ownerships of the South today. Not even the best of manufacturing methods and equipment can produce acceptable lumber from such basically poor raw material -- wood that might better be channeled to pulp, particle board, or some other use for which it is fitted.

Lest some of our western friends feel that the present predicament of southern pine is somebody else's problem, and one that may even operate to their advantage, let me hasten to call attention to two important facts: (1) consumer reaction to poor lumber of any species has an adverse effect on the already shaky competitive position of the entire lumber industry, and (2) western mills will certainly encounter many of the same lumber-quality problems as they become more and more dependent on some of their sparsely-stocked, second-growth stands that haven't been too well managed from the standpoint of producing quality wood in economically feasible rotations.

One can be lulled into a false sense of security by figures. For example, the production of southern pine lumber by 5-year intervals since 1930 has been as follows:

<u>1930</u>	<u>1935</u>	<u>1940</u>	<u>1945</u>	<u>1950</u>	<u>1955</u>
7,450 MM	5,960 MM	10,163 MM	7,210 MM	9,939 MM	8,772 MM

This looks pretty good, but what is the record of the percentage of total lumber production held by southern pine for the same years?

<u>1930</u>	<u>1935</u>	<u>1940</u>	<u>1945</u>	<u>1950</u>	<u>1955</u>
25.4	--	32.6	25.6	26.1	21.5

The drop from 1940 to 1955 of over 11 percent seems to me to be very significant, since it corresponds to a period of great expansion in pulp capacity.

A number of factors have contributed to the slump. A rise in pulpwood prices has created difficult, sometimes impossible, conditions for procurement of good saw logs in spite of considerable trading of logs between pulp mills and sawmills. Add to this the fact that a great deal of sawtimber-size material has been made into pulp, and a reason for part of the drop is evident.

I do not know all the reasons back of the heavy pulping of saw logs and the resultant loss of this raw material to the lumbermen, but I do know the situation exists and is serious. One may assume, without much proof, that some large land-owning pulp companies have been obtaining as much wood as possible outside their own lands in order to build up their own growing stock -- good forestry and good business, perhaps, for the pulp company but sometimes rough on sawtimber supply and quality.

Many sawmill men, as a result of this sort of competition for available stumpage, are forced to use logs of smaller average size, to be less selective of log quality, and to cut more expensive lumber of lower average quality.

This intense competition for stumpage also leads to much premature heavy cutting of good young timber that would otherwise develop into prime saw logs. Premature heavy cutting, for saw logs as well as pulpwood, is all too common in the South, especially on lands of the small owners who hold the key to the region's future timber supply.

In many northern and eastern markets southern pine lumber is not even stocked today, in spite of the fact that the market needs lumber and will

pay for good stuff. Advertising and sales promotion alone, important though they may be, cannot be depended upon to recapture and hold lost markets. Such programs aren't likely to have much effect on the home owner whose house was framed with unseasoned, poor-quality southern pine, and whose drywalls buckled, ceilings cracked, and doors all jammed when he first started his central heating system! That man, along with all the other once-burned consumers, is now of the opinion that southern pine is unfit to use and should be banned from commerce. These people will have to be convinced that good, well-seasoned, southern pine lumber is an entirely different product -- as good as any for house framing and other important uses.

The greatest single need, I repeat, is to improve and maintain the quality of southern pine lumber.

There are many opportunities for progress in this direction, all of which are receiving some attention. High on the list should be more positive action to channel logs of sawtimber size and quality to the sawmills. It seems to me that more trading of logs and stumpage would be of advantage to both the pulp mills and the lumbermen, and would result in better use of available raw material.

The larger, timber-owning forest industries might also look into the advantages of integrated utilization along lines followed by the Crossett Company, where each product of the forest is channeled to the end use for which it is best suited.

The most important opportunity -- and the greatest challenge to southern foresters -- is for increasing the productivity of southern timberlands up to their biological potential, so that there will be ample good pine timber for the lumberman as well as the voracious pulp and paper mills and other wood-using industries. The South has the land, the species, the climate, and the technical knowhow to do the job, and good progress has been made by the larger owners and on public lands.

But the smaller ownerships are still largely understocked and are producing much less timber than they should. Moreover, they are growing too much wide-ringed, low-density wood that is low in fiber yield, low in mechanical strength, high in shrinkage, and has a marked tendency to warp. This is the kind of poor-quality timber that has given southern pine a black eye in the market place -- a situation that must be corrected.

In moving in the direction of more intensive forestry, I hope that southern timberland owners do not widely follow the short-rotation, single-product

type of management currently favored by some pulp companies. Such a system may be well suited to the peculiar requirements of a pulp company, although I have some reservations on this score, but it is most certainly not the most advantageous or profitable system for forest farmers whose end product is stumpage, logs, or some other primary wood product. Moreover, widespread practice of pulpwood forestry would have an undesirable effect on all other wood-using industries and the whole timber economy of the region, to say nothing of the Nation's future lumber supply. A major trend in this direction would be undesirable from any viewpoint.

I trust, therefore, that southern forestry will move in the direction of full stocking on every acre, rotation ages sufficient to yield good-sized saw logs, poles, or piling at the harvest cuts, and stand management designed to attain the moderate, even rate of diameter growth that produces the maximum of high-density, high-quality wood for the final harvest and substantial amounts of pulpwood removed in thinnings and intermediate harvest cuts. I believe that this kind of forestry, together with better protection from all destructive agencies, can achieve the desired production and quality goals, and that it will better serve both producers and processors of wood products than a one-product forest economy.

The timber-growing job can be done with better management of existing run-of-the-woods growing stock, but it can be accomplished faster and more efficiently with the superior trees now being developed by research. At this point I want to congratulate the South on its leadership in forest genetics, the progress made in the selection and breeding of better trees, the pioneering of commercial-scale seed-production areas and true seed orchards, and its rapidly expanding planting program.

The Laboratory, I am happy to say, is active in the genetics field and is working closely with the Committee on Southern Forest Tree Improvement and other groups in the South. Our main interest, of course, is in selection and breeding for superior wood properties, such as high density and low fibril slope. Right now, in cooperation with the Southern Station, we are making wood-quality determinations on increment cores taken from some 12,000 pines sampled in connection with the Forest Survey of Mississippi. To date we have turned up several trees that are much better than any on record with respect to desirable combination of specific gravity and growth rate -- and we have just scratched the surface in this long-neglected field.

"Extemporaneous" comment to audience at this point:

Some of you Westerners who have been making some rather tall claims about what you are doing in forest genetics had better take a look around while you are in the South. Some of the work under way at places like the Georgia Forestry Center, the Lake City Research Center, and some of the pulp company experimental forests will make your eyes pop.

Given the kind of forestry and growing stock needed to produce optimum yields of pulp and sawtimber from the same acre, there remains the problem of getting saw logs to well-equipped sawmills. The problem of the small, itinerant, or "peckerwood" mill is perennial in the South. Subject to no organized inspection or control, it continues to furnish low-quality, mismanufactured lumber to a disorganized market. There are some indications that the higher minimum wage may operate in the direction of eliminating many of these mills. While one may wish sentimentally for their survival, a hard look at the welfare of the lumber industry dictates otherwise.

Other opportunities in the utilization field that will favor a better balance between pulpwood and saw logs and lead to a healthier timber economy include increased use of hardwood timber and sawmill residues by the wood-hungry pulp and paper industry. Substantial advances in either field would lessen the pressure on softwood growing stock.

The last few years have seen the installation of debarkers and chippers in practically all of the larger sawmills and in many of the medium-size mills. As a result, chips from this source reaching southern pulp mills increased to 374,132 cord equivalents in 1955, as compared to a mere trickle a decade ago. Progress has been good, but there remains a vast volume of chippable residues that are now largely wasted at the medium and small sawmills and innumerable other wood-processing plants. The key to this as yet untapped supply of raw material appears to be an efficient, portable, relatively inexpensive debarker that will handle slabs and edgings at the smaller mills or local concentration yards for such coarse sawmill waste.

Progress has also been made in using more hardwood timber in pulp and paper manufacture, with consumption up to 2.53 million cords in 1955, an increase of 17.5 percent over the previous year. But hardwoods account for only 14 percent of the total pulpwood produced in the South, so we still have a long way to go in utilizing surplus hardwoods.

A wide technological background has been developed at the Laboratory on the pulping of hardwoods. In fact, we have been criticized at times for spending so much time on this problem. We do not yet have all the answers

and need to do more research in this field particularly for certain specific uses, but I can also say on good authority, that there are no really insurmountable technical obstacles to greater use of hardwoods by the pulp and paper industry. In other words, it isn't entirely lack of technical know-how that is holding up more rapid progress.

One reason, I believe, is that the pulp and paper industry, despite its relative youth, vigor, and progressive attitude, isn't entirely free of some of the inertia and resistance to change that afflicts the older and more tradition-bound lumber industry. This was evidenced by the initial resistance of operating personnel to chips from sawmill residues, which have since proved as good or better than chips from round wood; and it shows up to-day as a rear-guard action against the inevitable trend toward greater use of hardwoods.

Another deterrent is the substantial cost of converting equipment and processes to handle hardwoods, especially at some of the older mills. From one standpoint, maybe the overcutting of pine in some mill procurement areas is a blessing in disguise. It may hasten the day when production, and certainly any expansion of capacity, will have to be based largely on hardwoods. In the long pull, this will tend to lessen the pressure on the pine growing stock.

To sum up, the national requirements for softwood lumber make very necessary the rebuilding of the southern pine lumber industry, in both quality and quantity. The necessary rebuilding will have to be accomplished while an increasing demand for pulpwood is being met. Available information and continued progress in putting it to work give grounds for optimistic belief that the job will be done, and that there will be good wood in sufficient quantity for both pulpmills and sawmills from the same lands.

Before we leave the subject of softwoods, just a little about other utilization channels will be in order. First, lamination: Modern high-speed machinery, glues, and methods make possible the fabrication of many useful products from small odds and ends of otherwise good lumber resulting from the manufacturing process. This is good, close utilization. There still persists in some quarters, however, the idea that the lamination process offers an excellent means of profitable use of inferior lumber. In this connection it should be emphasized that material for laminating successfully cannot be much lower in grade than ordinary lumber for the same uses. By no process that we know can lumber that in its ordinary state is mechanically weak or subject to warping be laminated into products that will not inherit these same properties. In general, lamination is most

useful for the fabrication, from good boards, of material in sizes and shapes that are difficult or impossible to cut from logs of normal size -- large trusses, arches, ship keels, and the like. Here we have an opportunity to recapture some of the markets lost to steel and other metals. We can look forward to a steady growth in the laminating industry.

Now a word about fiberboards, both those of the insulating type and the familiar pressed hard fiberboards. These materials continue to increase in volume and can and do take mill waste, woods waste, and, in many cases, round wood of pulp or even saw-log size. They are gradually approaching good standards and predictable properties for the uses for which they are adapted. Doubtless their production will continue to expand and fill an important place, especially in the recovery of leftover materials. From the utilization standpoint, and in the interest of improving the quality of southern pine lumber, most of the small, low-quality logs now going to the sawmills probably ought to be channeled to either the pulp mills or the fiberboard industry.

It should be mentioned that, generally speaking, comparatively large capital investments are required for the manufacture of fiberboards by most of the conventional wet felting processes. Our figures show that the lower limits of investments for these mills are around one million dollars. Such investments appear low when compared to the capital needed for a pulp and paper mill, but are large in comparison to price tickets on lumber production plants.

The particle boards, which are dry-formed of particles of varying shapes and sizes held together by some type of resin bond, are increasingly important. Unfortunately, at the present time there is lack of standardization and, generally, a lack of realization that such boards do not adequately take the place of lumber items in many fields for which their use is sometimes recommended. This is probably a natural situation in such a young industry, and great strides are being made toward remedying these troubles.

At the level of our present knowledge, I foresee no miracles emerging from the particle board field. By this I mean that the products hitherto examined, while perfectly satisfactory for many uses, do not develop the oriented strength properties required in housing construction, where loads, bearing strength, and the like, are criteria for judging suitability. They do, however, have many broad fields of adaptability, but their use must be kept in line with the water and heat resistance of their binder.

There are two or three primary considerations that ought to be mentioned. First, the size and shape of the particles used in manufacture have a great

deal to do with determining the amount of resin required and the final properties of the board. The smaller the particles, the more resin required. We have experimentally developed, from particles of certain shapes, boards that approach the properties of plywood. When such boards are made with a weather-proof resin, they should find wider applicability, provided their cost is sufficiently low. Therein, we believe, lies the greatest avenue of potential progress in this field, namely, the formulation of adhesives for outside use at much lower cost than those now available.

It is too often the case that the possessors of small aggregations of capital are falsely persuaded that great profits can arise from the simple putting together of sawdust and a resin of low moisture and heat resistance, and thereby embark on a production program without adequate market knowledge. Unfortunately, some of these enterprises will not make the grade, and the whole particle board industry may suffer temporarily as a result.

In the long run, however, particle boards that are properly made and sold for the uses for which they are suited will enjoy an increasing market. They are a welcome addition to the growing list of wood-using industries that thrive on scraps and leftovers, and thereby help relieve the pressure on the softwood growing stock.

Hardwoods

Since we are meeting in the hardwood capital of the world, where hardwoods are king and pine forestry a dirty word, it is appropriate, if not mandatory, to consider the hardwoods.

Essentially the hardwood situation in most of the South, as well as in other important hardwood regions, is characterized by poor quality of growing stock and under utilization. I assume you are all aware that about half of the total area and net volume in southern forests are hardwoods, that the volume of hardwood cull trees exceeds one-third of the total hardwood growing stock, and that growth of hardwoods is far greater than the harvest.

Hardwood utilization for most of the conventional products that have been made from hardwoods -- lumber and veneer -- has led to what is pretty largely a high-grading operation, with the resultant accumulation of a heavy overburden of low-grade trees and unwanted species left over from previous cutting. The core of this management-utilization problem is the development of uses and mass markets for hardwoods that are less choosy of quality

and species and that will: (1) facilitate the removal of the present heavy concentration of poor stuff, the first step in rebuilding the growing stock and restoring the productivity of our once fine hardwood forests; and (2) permit the removal, without heavy capital investment, of the scrub hardwoods that have invaded lands best suited to pine.

To quote one of your own authorities, hardwood forestry in the South is about 25 years behind pine, both in silvicultural knowledge and its application on a wide scale. That fact, together with the complexity of hardwood management, is at least partly responsible for the present unsatisfactory condition of our hardwood forests.

Improvement in the quality of the wood produced on predominantly hardwood sites would soon bring growth and harvest into better balance. I don't see any indication of a slump in the demand for good hardwood lumber and veneer that is produced in quantity at a reasonable price. Production has been rather steady at around four billion feet for the last 10 years, and there is no reason to anticipate any major changes in the demand for good hardwood lumber and veneer.

The problem, therefore, is to find outlets for the surplus of poor material so that we can move toward better forestry and improved quality in our hardwood forests. We have no panacea to offer yet to aid in the solution of this problem. However, in the long view I believe we can see a great deal of encouragement, including possible mass utilization that will do for hardwoods what kraft pulp did for pine.

Before we explore potential mass markets, let us consider some of the other markets for low-grade hardwoods. High on this list is charcoal. Once in a while, in fact quite often, somebody gets the idea that this whole problem could be and ought to be solved by the production of charcoal. Now, charcoal is about the best woods-scavenging industry we have ever had. It can make a satisfactory product out of about any variety or quality of hardwood that grows. You all know what happened to the old charcoal industry, but developments in recent years have been along entirely different lines from those that characterized that old industry -- comparative small units with no byproduct recovery and requiring comparatively small capital investments. As long as they are not too abundant they are doing well. Last year there was an overall conversion to charcoal of somewhere around 1,000,000 cords of hardwood, mostly cull and down timber and slab waste.

About 60 percent of the total production of charcoal is in the form of lump and briquettes for the domestic fuel market. How much of it goes for

backyard barbecues is anybody's guess, but the proportion is heavy. The other 40 percent is consumed chiefly in chemical and metallurgical markets. There is little question that if the present rate of growth in these markets continues there will be a steady increase in charcoal production. But even then, the total consumption foreseeable for the next few years of perhaps a million cords will still only take one-half billion feet of timber, a very small contribution to the overall utilization job.

At the Laboratory we have been learning how to cut veneer from hardwood species and grades not previously used for this purpose. We have also had some success in upgrading low-quality hardwood lumber with paper plastic overlays that mask defects, improve stability, and provide a good painting surface. Further developments in these products will be helpful but, like charcoal, will make only a dent in our stockpiles of low-quality hardwoods.

Now a few words about the possibilities of fiberboard manufacture. The largest manufacturer of hardboards is now using hardwoods, including hickory, as a principal source of raw material. In effect, this is a raw pulp product. There is no particular reason why we should look for other than a steady growth in production as hardboard requirements continue to expand.

With respect to particle board the situation is not quite as promising. The cheapest wood and, all things considered, the most satisfactory for these processes is softwood mill waste. Technically there are no reasons why satisfactory particle board cannot be made from the hardwoods, but for particle boards in general the species with higher specific gravity are less desirable than those of lower density. There are, of course, some hardwoods with low or intermediate densities that can be satisfactorily used. The reason for the undesirability of high-density woods is that it takes more pressure to make the bond, and the resultant board is usually at least 20 percent higher in specific gravity than the species of wood used. With a dense species like oak, for example, the end product may be too heavy for core stock, or other uses, and the added shipping costs may put such a board in a poor competitive position. These matters do not preclude the use of hardwoods for both fiberboards and particle boards where competitive conditions permit.

One of the most promising fields for hardwood utilization lies in the general wood pulp field. As pointed out earlier, the South consumed approximately 2.53 million cords of hardwoods for pulp in 1955. The percentage of the hardwood pulp component in southern pulp production may be expected to increase with expansion of the industry and as certain new processes achieve wider use.

The oldest method of pulping hardwoods, the kraft process, produced a little over 600,000 tons of pulp from hardwoods in the South in 1955. The newest process, the semichemical, produced 628,000 tons, most of which represents a spectacular growth since the war. The applicability of the semichemical processes, which are capable of producing high-yield pulps from hardwoods, is quite broad. All indications are that much expansion of hardwood consumption by these processes may be expected in the South. Further cheap processes capable of taking woods-run hardwoods and converting them into useful pulps of wide applicability are being developed. Therefore, I believe we can look with assurance toward a large expansion of consumption of hardwoods by the pulp industry in the South.

This expansion will not for a long time solve the utilization problems except locally, because I think it can be confidently predicted that these pulp-industries will prefer the soft hardwoods, such as the gums, poplars, and cottonwoods; but there are enough indications of very large expansions of pulp capacity that will depend upon oaks and other heavier species to warrant an optimistic look into the future.

We are quite proud of the contribution of forest products research in these fields. The semichemical industry began with a modest plant at Knoxville operating with extracted chestnut about 30 years ago. Present day processes are much more highly developed and much more broadly applicable, both in woods processed and products produced, than those early attempts.

Most of you can recall various efforts to found a chemical industry upon wood. Rarely have these met with success. In times of national emergency, production of chemical goods from wood has paid out, but these ventures have usually succumbed with the arrival of peace. It is true that there are now several plants using spent sulfite liquor for the production of ethyl alcohol and yeast, but this is an example of a byproduct of a major industry, namely, wood pulp. Similarly, tall oil recovery from southern kraft plants is prospering as a byproduct of a major industry.

Some years ago we took a very hard look at the possibilities of founding successful chemical processes based on wood, not from the point of view of single product production but from that of an integrated chemical industry. We came to the conclusion that there are strong possibilities of accomplishing this desirable end, especially if we aim at several products. The objective is, of course, the creation of an industry capable of converting the heterogeneous woods-run of hardwoods into chemicals at a profit. I will not burden you with technical details, but since the war we have been doing everything we can to lay a firm technical basis in this field. For

example, we are for the first time in possession of the basic data on rates of wood hydrolysis under a range of conditions broad enough so that we can design a conversion plant that will work under optimum conditions.

Hardwoods contain more pentosans than softwoods. Furfural is made from pentosans. The demand for furfural is large and increasing. We believe in our new process the pentosan fraction ought to be separated first from the rest of the wood and processed separately. That is being done, and again the basic engineering data needed to design such a conversion plant are being obtained.

Next, we want to be able to separate the cellulose fraction and convert it into not just one chemical but several, so that production can be shifted as necessary to meet the demands of the chemical market. The basic information on the reactions leading to these conversions is being obtained as rapidly as can be done.

We shall, we hope, have a lignin fraction with properties that will make it valuable. Older processes degraded this material to the point where it was not a satisfactory producer of useful chemicals. We believe that the types of processes we are now developing will give us a real flow of chemical goods from this source to supplement other products and bear a part of the total processing cost.

There in a very rough thumb-nail sketch is what we think we see in the future. I don't know when. Our boys tell me it may be 10 years before we shall be through the final pilot-plant stage in the development of such a process. That seems like a long time, but there is a lot of work to do and the rewards, if we are successful, will be great. For the first time we shall have a satisfactory process that can take all of the material from the forest and convert it at a profit into commercial chemical goods. Obviously, that tool, if and when it is developed, will have to be used as a proper supplement to the processing of hardwood lumber, hardwood plywood, and hardwood pulp. Properly used, it can be of tremendous benefit to southern forests. Like any other utilization tool, including hardwood pulp, if it is improperly used there will be trouble.

Utilization tools are sharp tools and powerful ones, and they must be properly directed. When they get out of hand we have overcutting and unbalanced cutting. But those matters are the responsibility of the foresters. It looks to me as if, in most of the South, the organized forest industries pretty well understand that.

I don't know whether I have done very well in pointing out to you the solutions to the problems of southern forestry or not. That there are opportunities in utilization is clear. Our task is largely one of embracing those opportunities in such a manner as to move in the direction of solving our problems.

